WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS PATENT OF THE UNITED STATES IS:

1. A motion control system comprising:

a central controller configured to generate first and second demand control signals defining actuation motion of respective first and second actuators;

first and second nodes in communication with said central controller, each node including,

at least a respective one of said actuators configured to implement at an actuator time an action based upon said respective demand control signal, and

a memory configured to store at least one respective propagation delay parameter related to a signal propagation delay between the central controller and the node;

a timing mechanism configured to establish timing at each node based on the respective propagation delay parameter so that the actuator times at the nodes occur simultaneously; and

a data network configured to place said first and second nodes in communication with said central controller.

2. The system according to claim 1, wherein:

said first and second nodes further comprise respective transducers configured to measure at a transducer time respective parameters related to motion of respective of said actuators and to generate respective feedback signals;

said central controller is configured to receive said respective feedback signals indicative of motion of said first and second actuators; and

said timing mechanism is configured to establish timing at each node based on the respective propagation delay parameter so that said transducer times occur simultaneously at the nodes.

3. The system according to claim 1, wherein:

said first node further comprises a transducer configured to measure at a transducer time a parameter related to motion of said first actuator and to generate a first feedback signal;

said central controller is configured to receive said first feedback signal indicative of motion of said first actuator; and

said timing mechanism is configured to establish timing at said first node based on the first propagation delay parameter so that said transducer time at said first node occurs at a known time relative to a master time.

4. The system according to claim 1, wherein at least one of said first and said second nodes further comprises a current/torque controller.

5. The system according to claim 1, wherein:

said central controller comprises a synchronization signal generator configured to generate a synchronization signal; and

said timing mechanism comprises a synchronization signal receiver configured to receive said synchronization signal.

6. The system according to claim 5, wherein said timing mechanism further comprises:

an adder configured to add each said respective propagation delay parameter to an arrival time of said synchronization signal to provide said actuator time for each actuator.

7. The system according to claim 5, wherein said nodes each further comprise a local clock.

8. The system according to claim 7, wherein said timing mechanism further comprises:

a local clock setting mechanism configured to set each said local clock based on said synchronization signal and said respective propagation time along said data network from said central controller to each node.

9. The system according to claim 2, wherein:

said central controller comprises a synchronization signal generator configured to generate a synchronization signal; and

said timing mechanism comprises a synchronization signal receiver configured to receive said synchronization signal.

10. The system according to claim 9, wherein said timing mechanism comprises:

an adder configured to add said respective propagation delay parameter to an arrival time of said synchronization signal to provide at least one of said actuator time and said transducer time.

11. The system according to claim 10, wherein:

said nodes each further comprise a local clock; and

said timing mechanism further comprises a local clock setting mechanism provided at each node and configured to set said local clock based on said synchronization signal and said propagation time along said data network from said central controller to each node.

12. The system according to claim 1, wherein said central controller comprises a master controller and said first and second nodes comprise a first slave node and a second slave node, respectively.

13. The system according to claim 1, wherein said data network comprises a tree topology.

14. The system according to claim 1, wherein said data network comprises a ring topology having a forward direction and a reverse direction.

15. The system according to claim 14, wherein said ring topology comprises a full duplex ring.

16. The system according to claim 14, wherein said central controller further comprises:

a transmitter configured to transmit a signal along said ring topology; and

a receiver configured to receive an answer to said signal, said answer transmitted along said ring topology.

17. The system according to claim 16, wherein said central controller further comprises:

an identifier configured to identify a furthest node along said ring topology in a forward direction from which said answer can be received at said receiver.

18. The system according to claim 14, wherein said propagation delay parameter memory comprises:

a forward path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a forward direction along said forward direction to said node; and

a reverse path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a reverse direction along said reverse direction to said node.

19. The system according to claim 1, wherein said central controller is configured to autoenumerate said first and second nodes.

20. The system according to claim 1, wherein:

said central controller further comprises,

a query message transmitter configured to transmit a query message along said data network, and

an answer message receiver configured to receive an answer to said query message; and

said first and second nodes each comprise,

a query message receiver configured to receive said query message from said central controller, and

an answer message transmitter configured to transmit an answer message replying to a received query message, said answer message transmitted along said data network, said answer message enumerating said node.

21. The system according to claim 20, wherein said first node further comprises a relay configured to pass along said query message to said second node when said first node has already been enumerated.

22. The system according to claim 20, wherein said second node further comprises a relay configured to pass along said query message to said central controller when said second node has already been enumerated.

23. The system according to claim 20, wherein:

said query message is transmitted in a forward direction; and

said answer message is transmitted in a reverse direction.

24. The system according to Claim 1, wherein said timing mechanism is disposed at each of said nodes.

25. A method of synchronizing the operations of a plurality of actuators in a system for motion control, comprising:

determining a respective propagation delay between a central controller and each actuator of said plurality of actuators; and

timing operations of each actuator based on said determined respective propagation delay for each actuator.

26. The method according to claim 25, wherein said timing step comprises simultaneously initiating actuation of each actuator of said plurality of actuators.

27. The method according to claim 25, further comprising a step of timing operations of transducers associated with servo-actuators of said plurality of actuators based on said determined respective propagation delay.

28. The method according to claim 27, wherein said timing operations of said transducers step comprises simultaneously initiating measurement by said transducers.

29. The method according to claim 25, further comprising:

transmitting a synchronization signal from said central controller to said each actuator of said plurality of actuators.

30. The method according to claim 29, wherein said timing step comprises offsetting the operations of each actuator of said plurality of actuators relative to said synchronization signal based on said respective determined propagation delay for each actuator.

31. The method according to claim 25, further comprising:

storing a parameter related to said respective propagation delay for each actuator of said plurality of actuators.

32. The method according to claim 25, wherein said determining step comprises:

transmitting a query signal from a central controller to a node having said actuator of said plurality of actuators at a transmission time;

receiving said query signal at said node;

replying to said query signal through an answer signal transmitted from said node to said central controller;

receiving said answer signal at said central controller at a reception time; and

determining said propagation delay based upon a difference between said transmission time and said reception time.

33. The method according to claim 25, wherein said determining step comprises:

summing predetermined relay times for preceding actuators between said central controller and a particular actuator and propagation times for preceding links between said central controller and said particular actuator to yield said propagation delay of said particular actuator.

34. The method according to claim 30, wherein said offsetting step comprises:

delaying said operations of each actuator of said plurality of actuators by said determined propagation delay.

35. A method of autoenumerating a plurality of nodes controlled by a central controller in a system for motion control, comprising:

linking the central controller and the nodes in a network;

transmitting a query message from the central controller in along said network;

receiving said query message at a node of said plurality of nodes in said network;

transmitting an answer message to said query message along said network from said node to said central controller, said answer message enumerating said node;

receiving said answer message at said central controller;

retransmitting said query message from said central controller along said network;

relaying said retransmitted query message through said enumerated node to a further node; and

transmitting a further answer message to said query message along said network from said further node through said enumerated node to said central controller, said further answer message enumerating said further node.

36. The method according to claim 35, wherein said query message is transmitted in a first direction and said answer message is transmitted in a reverse direction.

37. The method according to claim 35, wherein said linking step comprises arranging the central controller and the nodes in a ring network.

38. The method according to claim 37, further comprising:

repeating said steps of retransmitting said query message, relaying said query message, and transmitting a further answer message until said further node comprises a last node in said ring network;

transmitting said query message from said central controller along said ring network;

relaying said query message through each node in said plurality of nodes; and

receiving said query message at central controller.

39. The method according to claim 35, further comprising a step of determining a propagation delay between said central controller and each node in said plurality of nodes.

40. A method of maintaining operation in the event of a fault of a system for motion control with a plurality of nodes in a ring network controlled by a central controller, comprising:

transmitting first messages addressed to plural respective nodes in a first direction along said ring network;

monitoring first reply messages transmitted by said plural nodes in a second direction along said ring network in response to the transmitted first messages;

identifying, when first reply messages are not received from each node to which a first message was transmitted, a first subset of nodes from which said first reply messages are received, and based thereon, determining a second subset of nodes exclusive of said first subset of nodes, from which respective first reply messages were not received;

transmitting in said second direction, when first reply messages are not received from each node to which a first message was transmitted, second messages addressed to respective nodes in said second subset of nodes;

receiving second reply messages transmitted by respective of said nodes of said second subset of nodes in response to said second messages, said second reply messages traveling in said first direction along said ring network;

transmitting in said first direction third messages addressed to said first subset of nodes; and

transmitting in said second direction fourth messages addressed to said second subset of nodes.

41. The method according to claim 40, wherein said ring network comprises a full-duplex ring network.

42. A motion control system, comprising:

means for determining a respective propagation delay between a central controller and each actuator of said plurality of actuators; and

means for timing operations of each actuator of said plurality of actuators based on said determined respective propagation delay for each actuator.

43. An autoenumerating motion control system comprising:

a network;

a central controller and plural nodes communicating with each other via said network;

the central controller including,

means for transmitting a query message from the central controller along said network, and

means for receiving said answer message at said central controller; and

said nodes each including,

means for receiving said query message carried by said means for linking,

means for transmitting an answer message to said query message along said means for linking from said node to said central controller, said answer message enumerating said node, and

means for relaying a further query message through said enumerated node to a further node and a further answer message to said query message along said network from said further node through said enumerated node to said central controller, said further answer message enumerating said further node.

44. A system for operating a plurality of nodes controlled by a central controller via a ring network in the event of a fault, comprising:

means for transmitting first messages addressed to plural respective nodes in a first direction along said ring network;

means for monitoring first reply messages transmitted by said plural nodes in a second direction along said ring network in response to the first messages transmitted by said means for transmitting first messages;

means for identifying, when first reply messages are not received from each node to which a first message was transmitted, a first subset of nodes from which said first reply messages are received, and, based thereon, for determining a second subset of nodes exclusive of said first subset of nodes, from which respective first reply messages were not received;

means for transmitting in said second direction, when first reply messages are not received from each node to which a first message was transmitted, second messages addressed to respective nodes in said second subset of nodes;

means for receiving second reply messages transmitted by respective of said nodes of said second subset of nodes in response to said second messages transmitted by said means for transmitting in said second direction, said second reply messages traveling in said first direction along said ring network.

45. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 25.

46. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 26.

47. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 27.

48. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 28.

49. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 29.

50. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 30.

51. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 31.

52. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 32.

53. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 33.

54. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 34.

55. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 35.

56. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 36.

57. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 37.

58. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 38.

59. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 39.

60. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 40.

61. A computer readable medium storing instructions for execution on a computer system, which when executed by a computer system, cause the computer system to perform the method recited in claim 41.

62. A node configured to be in communication with a central controller over a data network, said node comprising:

a delay correction memory configured to store a delay correction signal related to a propagation delay between said central controller and said node over said data network; and

an actuator configured to implement a motion or force-related effort at an actuator time based upon said stored delay correction signal.

63. The node according to claim 62, further comprising a delay correction receiver configured to receive said stored delay correction signal related to said propagation delay.

64. The node according to claim 62, further comprising:

a node clock configured to maintain a node time;

a clock setting mechanism configured to set said node time of said node clock based upon said stored delay correction signal,

wherein said actuator time based upon said set node time.

65. The node according to claim 62, wherein said node being connected in a full-duplex ring and said delay correction signal comprising a forward path delay correction signal and a reverse path delay correction signal.

66. The node according to claim 62, wherein said delay correction signal comprising a forward path delay correction signal.

67. A node configured to be in communication during operation with a central controller over a full-duplex data network, said node comprising:

a first receiver configured to receive a first signal transmitted along a first direction over said data network;

a second receiver configured to receive a second signal transmitted along a second direction over said data network; and

an actuator configured to implement an action based one of said received first signal and said second signal.

68. The node according to claim 67, further comprising:

a first reply transmitter configured to answer said first signal in said second direction;

a second reply transmitter configured to answer said second signal in said first direction;

a selector configured to select said first reply transmitter when said first signal is received and said second reply transmitter when said second signal is received.

69. The node according to claim 68, further comprising:

a delay correction memory configured to store a forward path delay correction signal and a reverse path delay correction signal,

wherein:

said actuator is configured to implement said motion or force-related effort at an actuator time based upon a selected one of said forward path delay correction signal and said reverse path delay correction signal; and

said selector also is configured to select said forward path delay correction signal when said first signal is received and said reverse path delay correction signal when said second signal is received.